

# PART 2: TECHNICAL NOTES

The technical notes are the second of four parts contained in this module. They provide an overview of how to prevent and treat micronutrient malnutrition in emergencies. The technical notes are intended for people involved in nutrition programme planning and implementation. They provide technical details, highlight challenging areas and provide clear guidance on accepted current practices. Words in italics are defined in the glossary.

#### Summary

This module provides an overview of approaches for the prevention and treatment of micronutrient malnutrition in emergencies. Prevention is considered in terms of ensuring a nutritionally adequate diet through dietary diversification, fortification of food aid commodities, micronutrient supplementation programmes, promotion of appropriate infant feeding, and income generation and market access. Clinical treatment of the common deficiency diseases is also reviewed.

#### Introduction

The recognition, diagnosis and assessment of *micronutrient malnutrition* is discussed in detail in Module 4. Here, approaches to the prevention and cure of this important and persistent public health problem are considered.

Micronutrient malnutrition is commonly caused by an inadequate intake of one or more vitamins or minerals. Micronutrient malnutrition leads to impaired immunity as well as an increased risk of *morbidity* (illness) and *mortality* (death). Infectious diseases can worsen the problem of an inadequate diet. In addition, there is a vicious cycle connecting infection and malnutrition. Problems of low diet quantity and quality com-

binated with high rates of infections are commonly found in emergencies. For these reasons, it is essential that effective strategies to combat micronutrient malnutrition are developed and implemented in emergency situations.

Excessive intakes of micronutrients can also be harmful. For example, in the case of iodine, goitre may develop in people who have either too little or too much iodine in their diet, and very high levels of iron can be lethal. Most micronutrients have a defined safe upper level of intake. Regular consumption above this level carries a health risk. For these reasons, it is important that strategies for reducing micronutrient malnutrition ensure that intakes remain within recommended levels.

#### Case example 1: Excessive iodine intakes in long-term refugees

A series of nutrition surveys were conducted in long-term African refugee camps between 2001 and 2003. Urine samples were collected from adolescents and analysed for iodine concentration.

In five of the six camps that were surveyed, the median urinary iodine concentration indicated an excessive intake of iodine. The highest goitre prevalence was found in the camp with the highest iodine intakes.

The source of the excess iodine still remains unclear but caution is obviously needed when considering implementing programmes that may further increase iodine intakes in these and similar locations.

Source: Seal, A., et al., 'Excess dietary iodine intake in long-term African refugees', *Public Health Nutrition*, 22, 2006.

**Key messages**

1. Prevention of micronutrient malnutrition depends on achieving an adequate intake of the many micronutrients (vitamins and minerals) required by the human body.
2. Diseases can increase the requirements for micronutrients and can interact with malnutrition to cause morbidity and mortality.
3. Effective control of micronutrient malnutrition is likely to involve both curative and preventive approaches.
4. Options for the prevention of micronutrient malnutrition in emergencies can be classified into 11, often complementary, approaches:
  - 1) Inclusion of nutrient-rich commodities in food assistance rations
  - 2) Provision of fresh food items that are complementary to a general ration
  - 3) Provision of fortified foods
  - 4) Increasing the size of the general food ration to facilitate diet diversification by exchange or trade
  - 5) Distribution of food supplementation products for home fortification
  - 6) Distribution of micronutrient supplements
  - 7) Promotion of home gardening and agricultural development
  - 8) Increasing income generation and improving access to markets
  - 9) Promotion of recommended infant feeding practices
  - 10) Ensuring adequate health care and a healthy environment
  - 11) Ensuring access to adequate non-food items
5. An effective prevention strategy with long-term impact is likely to use a combination of these different approaches. Not all approaches can be used in all situations. For example, there may be no general food aid ration in some situations or there may be no spare land or water available for home gardening in others.
6. To treat a specific micronutrient deficiency disease high dose supplementation using a single or small range of micronutrients is usually required. This treatment should be accompanied by a good general diet and appropriate health care.
7. Micronutrient malnutrition can result from a deficiency or an excess of micronutrients. In designing any programme the possibility of excessive intakes of micronutrients needs to be considered.

Prevention is clearly better than a cure. Approaches to preventing micronutrient malnutrition are examined in addition to treatment.

**Prevention**

There is no one single approach to prevention that will be effective in all emergency contexts. However, as discussed below, it is possible to identify eleven approaches to prevention and to select from these a combination that will comprise an effective strategy.

**1 Inclusion of nutrient-rich foods in food aid rations**

As described in Module 4, *rations for general food distribution* are often composed of only a few commodities and are likely to be deficient in a number of micronutrients. However, parti-

cular commodities are good sources of certain micronutrients. For example, ground nuts (peanuts) are a good source of niacin (vitamin B3) and have been added to general rations with the aim of improving their niacin content in order to prevent *pellagra*. Identifying available commodities that are a good source of micronutrients and including them in food aid rations can be an effective, rapid, and cost-effective approach.

*Information, education and communication* with the recipient population about food processing and consumption may be very important in ensuring the best use of available food. People should understand the importance of different nutrients, which foods contain them, how to prepare the foods to preserve the nutritional value, as well as understanding what their food entitlements are.

**Case example 2** looks at what happened in Malawi when there was an interruption in the supply of ground nuts for Mozambican refugees in 1989 and 1990.

These technical notes are based on the technical references given in the resource list for the module and the Sphere standards shown in the box below:

## Sphere standard

### Food Security, Food Transfers Standard 1: General nutrition requirements

Ensure the nutritional needs of the disaster-affected population including those most at risk are met. (For a list of key indicators see module 4)

### Management of malnutrition standard 3: micronutrient deficiencies

Micronutrient interventions accompany public health and other nutrition interventions to reduce common diseases associated with emergencies and address micronutrient deficiencies

#### Key indicators

- Cases of micronutrient deficiencies are treated according to current best clinical practice
- Micronutrient interventions accompany public health interventions to reduce common diseases associated with emergencies such as measles (Vitamin A) and diarrhoea (zinc)

Source: The Sphere Project (2011). *Humanitarian Charter and Minimum Standards in Humanitarian Response*. Geneva: The Sphere Project.

## Case example 2: Ground nuts improve the niacin content of general rations in Malawi: 1989-1990

Outbreaks of pellagra occurred among Mozambican refugees in Malawi in 1989 and 1990. The general ration planned for these refugees comprised maize flour (400 g), pulses (60 g), groundnuts (20 g), oil (40 g), salt and sugar, and was supplied by the World Food Programme (WFP) and the United Nations High Commissioner for Refugees (UNHCR). It contained about 1900 kcal and ground nuts provided the major source of niacin. Prior to both outbreaks of pellagra there was 5-6 months disruption in ground nut distribution.

Between February and October 1990, 18,276 cases of pellagra dermatitis (due to niacin deficiency) were reported among 285,942 refugees. Overall, 6.3 per cent of the refugee population developed pellagra. A matched-pair case-control study confirmed the protective role of the daily consumption of groundnuts, as well as the benefit of garden ownership, and home maize milling.

Several plans of action were considered at the time of the second outbreak in order to alleviate the shortage of groundnuts. While awaiting mobilization of international resources and identification of groundnut supplies, a screening and treatment programme for all cases of pellagra dermatitis was developed and distribution of tablets containing multivitamin B complex began in August 1990.

At the same time, food delivery started to improve. Groundnut supplies were identified in several countries and transportation organized and coordinated by the Malawian government, Médecins Sans Frontières (MSF), Save the Children Federation (SCF) and UNHCR. These combined efforts helped to control the epidemic.

Source: Malfait, P., et al., 'An outbreak of pellagra related to changes in dietary niacin among Mozambican refugees in Malawi', *International Journal of Epidemiology*, 22, 1993.

## 2 Provision of fresh food items that are complementary to a general ration

A basic food ration often contains a cereal, pulse (bean), oil, salt and a blended food. This is often nutritionally deficient but the quality can be improved by the addition of complementary food items such as fresh vegetables and fruit and spices.

In refugee operations, there has been a long standing memorandum of understanding (MOU) between UNHCR and WFP covering the responsibilities for delivering adequate food and nutrition services. One of the areas covered by the MOU is the supply of complementary food items. These complementary food commodities include local fresh foods, spices, tea and therapeutic milk (to be used in *selective feeding programmes*). Such items are required under the terms of the MOU to be supplied by UNHCR when the need for them has been established by a joint assessment mission. The full wording of the relevant section of the MOU is given in the **Box 1**.

**Box 1: Responsibility for resource mobilization and milling in refugee operations**

WFP is responsible for mobilizing the following commodities, whether for general or selective feeding programmes: cereals; edible oils and fats; pulses (or other sources of protein when appropriate and jointly agreed upon); blended foods; salt; sugar; and high-energy biscuits. Where beneficiaries are totally dependent on food aid, WFP will ensure the provision of blended foods or other fortified commodities in order to contribute to preventing or correcting micronutrient deficiencies.

UNHCR is responsible for mobilising complementary food commodities when recommended by joint assessment missions or on the basis of specific health/nutritional and/or social assessments, particularly when refugees have limited access to fresh food items. These complementary commodities include local fresh foods and therapeutic milk (to be used in selective feeding programmes). UNHCR may mobilize spices and tea when recommended.

Within its assistance activities, UNHCR is responsible for ensuring adequate supplies of non-food items and services, in particular those relevant to the safe and effective use of food aid, such as cooking utensils, fuel, water and sanitation, medicine, soap and shelter. UNHCR and WFP should promote nutritionally and environmentally sound practices along with cooking techniques and technologies for saving fuel.

Furthermore, UNHCR and WFP will facilitate the mobilization of seeds, tools and fertilizers, in cooperation with relevant government bodies and competent United Nations and development cooperation agencies.

Source: *Memorandum of understanding between the Office of the United Nations High Commissioner for Refugees and World Food Programme, July 2002.*

Despite this agreement there are substantial resources, logistic and management challenges involved in delivering fresh food items on a regular basis to refugee camps, especially when they are located in remote and arid areas. Experience indicates that the difficulties involved often result in erratic and unreliable supply. This in turn may mean that the micronutrient content of the full ration falls short of what was originally planned.

In non-refugee situations the MOU (1996) between WFP and UNICEF may be of relevance to identifying the party responsible for different interventions. The box below contains some of the key provisions of the MOU as it relates to micronutrient nutrition.

**Box 2: Key provisions of the UNICEF/WFP Memorandum of Understanding**

5.3.4 When general food distributions are implemented, food baskets will be designed by WFP, based on the indicative energy, protein and micronutrient requirements established by FAO and WHO, adjusted as necessary by the specific situation of the beneficiary population, demography, food habits, access to other food resources, workload of women and logistic/security constraints. Guidelines for the design of food baskets will be developed by WFP in consultation with UNICEF.

5.3.5 To the extent possible, food commodities will be appropriately fortified. WFP and UNICEF will work together on advocacy with donor nations in favour of appropriately fortified foods. They will also work together to increase capacity for local milling and fortification of donated cereal products.

5.3.6 When the assessment indicates a significant risk of micronutrient deficiencies in a population, WFP will seek to address this through the inclusion of a fortified blended food or other fortified commodity in the general ration. UNICEF will be responsible for covering any unmet micronutrient needs through other measures (such as supplement distribution or provision of vitamin/mineral mixes).

Source: *UNICEF/WFP Memorandum of Understanding in emergency and rehabilitation interventions (1998)*

### 3 Provision of fortified foods

The increasing introduction of micronutrient-fortified foods in food rations since the mid-1990s, especially *blended food*, has probably helped to prevent major micronutrient outbreaks.

The vitamins and minerals added to fortified foods are known as *fortificants*.

- The *food vehicle* is the food to which fortificants are added.
- *Restoration* is when those micronutrients lost or removed during food processing are added back or restored in the final product.
- *Fortification* is the addition of micronutrients during or after processing a food, raising micronutrient levels above the amounts in the original food product. Fortification is sometimes also called *enrichment*.

Levels of fortification should be set so that the vitamin or mineral added will make a significant contribution to nutritional requirements, but not lead to a micronutrient intake above the safe upper limit. In addition, fortification must not alter the taste, smell, look, texture, physical structure or shelf-life of the food.

There are a number of types of food that may be fortified.

#### Cereals

Fortification of food aid staple commodities may be achieved at different stages of the logistic pathway. For example, in the case of donated maize grain this may occur in the donor country prior to international shipping, or it may occur in large mills at the national or regional level before shipping onwards to the site of the emergency. However, the great majority of food aid cereals are supplied unfortified. **Case example 2** looks at an example of where fortification at a large commercial mill was implemented in response to an outbreak of pellagra.

Not all commodities can be fortified. For example, rice is always distributed as grain rather than flour so it cannot usually be effectively fortified with a micronutrient premix powder.\* While maize can be milled and fortified prior to distribution, the shelf life of the milled grain is much reduced, leading to additional logistic challenges. The majority of cereals supplied in food aid operations are still supplied as unfortified whole grains.

Overall, as outlined in **Case examples 3 and 4**, United Nations (UN) and non-governmental organization (NGO) experience of direct involvement in implementing emergency food aid fortification has had varied results. Procurement of commercially-fortified products and a move toward home fortification are currently being promoted. However, despite the current reluctance of the relief community to involve itself directly in food fortification activities, guidelines on fortification have been recently released by the World Health Organization (WHO) and initiatives to increase the fortification of foods within developing countries continue to expand.

#### Case example 3: Fortification of maize flour for refugee feeding in Malawi: 1991

In August 1990, in cooperation with WFP and UNHCR, Save the Children United Kingdom (SC-UK) arranged a consultancy mission to determine if it would be practical to fortify maize flour with nicotinamide, and possibly other micronutrients, for refugees in Malawi. The consultancy found that this was technically possible and full-scale fortification began in an existing commercial mill in Malawi by the end of 1991.

Although the fortification of maize flour required careful planning and the importation of equipment, the technical infrastructure of the mills in Malawi allowed for its successful implementation. The process essentially consisted of using a feeder to add known amounts of nicotinamide to maize flour that was continuously flowing through a screw conveyor. The volumetric feeder comprised a gearing system that allowed for accurate delivery of the vitamin premix into the maize flour. The premix contained niacin, riboflavin, and thiamine and was added to yield values of 45 mg niacin, 4 mg thiamine and 3 mg riboflavin per kg of maize flour.

Although causal analysis was not performed, the implementation of fortification was associated with the end of pellagra outbreaks in the refugee population.

Source: Henry, C. J. K. and J. Seaman, 'The micronutrient fortification of refugee rations to prevent nutritional deficiencies in refugee diets', *Journal of Refugee Studies*, 5, 1992.

\* The use of technology for rice fortification (e.g. Ultra Rice® or NutriRice®) is under development but is still unproven in an emergency context.

**Case example 4: Implementation of camp level cereal fortification in Zambia: 2003**

To assess if milling and fortification of maize grain could be implemented at the level of the WFP extended delivery point, a pilot project was set up in a refugee camp in Zambia during 2003 using custom-designed milling and fortification technology.

Centralized milling and fortification of cereals on-site at a refugee camp was successfully implemented and was associated with a decrease in anaemia and stunting in 6- to 59-month-old children and in vitamin A deficiency in adolescents.

However, the management and logistic challenges presented by small and medium-scale fortification programmes have proven a barrier to the more widespread adoption by UN agencies or NGOs. Receiving donations or purchasing pre-fortified commodities from larger commercial providers is the currently favoured model for taking forward this particular approach to improving ration adequacy.

Source: World Food Programme, *Fortifying food in the field to boost nutrition: case studies from Afghanistan, Angola and Zambia*, Occasional Paper 16, WFP, Rome, 2006.

**Blended foods**

Blended foods typically consist of a milled and precooked mix of cereal and a pulse such as soya bean, to which oil and a mix of vitamins and minerals is added. Examples include corn soya blend (CSB), wheat soya blend (WSB), and corn soya milk (CSM). They are manufactured in many countries and regions where they are marketed under different brand names. These include Likuni Phala (Malawi), Famix (Ethiopia) and Unimix (East Africa).

Since the 1990s blended foods have been included in many food assistance operations where they are an important source of micronutrients in the diet. For some nutrients, such as vitamin C, blended foods may be the only source in the ration. There are various formulations of blended foods available and the specifications show a wide range of micronutrient content. Blended foods are produced in many countries and production within low-income, food-deficit countries has been supported by WFP.

Problems with the current formulations of blended foods include their high phytate content, which may prevent mineral absorption, and low energy densities.

**Salt**

Salt is routinely fortified with iodine in the form of potassium iodate or potassium iodide. The WHO recommends fortification of salt so as to achieve an iodine concentration of 20 to 40 mg/kg (20 to 40 ppm).

**Oil**

Oil is usually fortified with vitamin A. In recent years the policies of most major donors and WFP have required the provision of vegetable oil fortified with vitamin A. Current WFP specifications require vitamin A fortification of oil at 24,000-36,000 IU per kg and vitamin D at 2,400-3,600 IU per kg. Vitamin A is light sensitive so fortified oil should be stored in light-proof containers.

**Special nutritional products for acute use in disasters**

High energy biscuits (HEB) and BP-5 are examples of ready to use foods that are sometimes distributed in the acute phase of an emergency. They can be consumed without cooking and are usually fortified with a wide range of micronutrients.

**4 Increasing the size of the general food ration to facilitate diet diversification by exchange or trade**

One approach to enabling diet diversification is to increase the size of the general ration to facilitate trade and barter. This approach may be particularly useful when there are inadequate supplies of micronutrient-rich food aid commodities, and the beneficiaries have access to markets where micronutrient rich foods are available. Under these conditions, providing a larger ration of, for example, cereal grain, may allow recipients to exchange part of their ration for other preferred food items, thereby helping to ensure a more balanced diet. In **Case example 5** evidence is presented that highlights the importance of allowing exchange and trade, and that sales of food aid may represent distress rather than excess provision.

**5 Distribution of food supplementation products for home-based fortification**

Food supplementation products are intended to be used by recipients at home and added either to the household diet or that of its children. A variety of different products are now available. Effectiveness has not yet been proven in all cases and discussion of them in this training module is not an endorsement of any particular product. In considering what products may be suitable for a given setting the acceptability of products and approaches to the national and local authorities, such as the Ministry of Health, should be considered. Some products may not be usable in countries where product approval and licensing has not taken place.

**Case example 5: Sale of food aid may help diet diversification in Zaire: 1996**

In 1996 the sale and export of food aid from refugee camps near Uvira, Zaire, prompted a reduction in donated rations. However, research revealed that the sales did not reflect an excess of food in the camps. The sales were provoked by the absence of important components of the food basket, by cultural aversion to the staple (maize) and oil provided, by difficulties in food preparation, and by the refugees' limited ability to diversify their diet and cover pressing non-food needs.

Food sales improved the micronutrient content of diets but at the expense of energy lost from an already energy-deficient diet. At most, 23 per cent of the refugee households were eating adequate diets; the poorest one-fifth of households were twice as likely to sell or exchange food than other households and their diets were the worst.

Source: Reed, B. A. and J. P. Habicht, 'Sales of food aid as sign of distress, not excess', *The Lancet*, 351, 1998.

**Food supplementation products**

A number of types of food *supplementation* products are available.

*Micronutrient powders (MNP)* consist of micronutrients in a dry powdered or granulated form and are typically packaged in sachets that may contain the dose for a single individual for a single day or a household or institution for an extended period of time. They do not contain additional macronutrients and are intended for addition to the normal food of an individual or household. Their success has been documented mainly as a curative and preventative product for anaemia in children. Micronutrient powders are sometimes referred to as Sprinkles™. Sprinkles™ is one of several brands of micronutrient powders that are currently available or under trial.

*Lipid Nutrient Supplements (LNS)* are high-viscosity (oily) fat-based products prepared by mixing dried powdered ingredients with a vegetable fat. Being a fat-based product, spreads tend to have a high energy density and to be resistant to microbiological contamination. They are designed to be added to household foods and increase the micronutrient and lipid (fat) content.

Products are aimed at infants and young children (e.g. Nutri-butter®) or at other population groups (e.g. QBmix®). They may be designed for preventing anaemia and stunting or for preventing micronutrient deficiency diseases such as Scurvy and Pellagra.

**Home-based fortification**

Home-based fortification, through the use of a MNP or LNS, takes place by pouring, squeezing or sprinkling the product onto food after cooking. It has been increasingly used to improve the micronutrient content of the diet of young children and to successfully treat anaemia. However, published evidence on its use in emergencies is still scant.

It is known that home-based fortification using a fortified sauce has proved acceptable in a small-scale pilot project in Angola, and distribution of a micronutrient powder was reported to be feasible and effective as a complement to a selective feeding programme in Haiti in 2005-2006. Large-scale distribution of a micronutrient powder to children aged 6 months to 12 years in families displaced by the Tsunami was also successfully implemented in Aceh and Nias provinces of Indonesia in 2005 and 2006. However, the impact of the distribution on nutritional status was not measured.

However, there have been few detailed studies on how beneficiaries use Food Supplementation Products under conditions in an emergency. More information is required before their use can be incorporated into routine programme planning.

Although the problem is very unusual, as mentioned above, micronutrients may at times be consumed in excess amounts and this may lead to associated clinical or sub-clinical conditions. There is a trend towards the increased use of fortified commodities and food supplementation products in emergencies. There are also persistent issues of quality control in food fortification. Taken together, these issues emphasise the need for greater attention to be given to the possibility of excessive intake of micronutrients. This potential problem deserves careful consideration in programme planning and evaluation.

**6 Distribution of micronutrient supplements**

The distribution of micronutrient supplements in the form of capsules and tablets is a critical approach in combating micronutrient malnutrition. Vitamin A capsules for children and iron and folic acid tablets for pregnant women are well established components of preventive public health programmes.

### Vitamin A supplementation

Vitamin A deficiency is endemic in many parts of the world and has been long recognized as occurring under conditions of food shortage. Emergency-affected populations are often subject to pre-existing marginal vitamin A status and a high prevalence (rate) of *acute malnutrition* and infectious disease. *Xerophthalmia* (clinical signs of deficiency) was documented during the Irish potato famine of 1845-1850, and has subsequently been frequently reported during nutritional emergencies.

Following a large influx of refugees into eastern Sudan in 1984-1985, exceedingly high rates of xerophthalmia were observed. In recognition of the recurring and unnecessary morbidity associated with vitamin A deficiency, recommendations for a standard prophylactic supplementation regimen in emergencies were proposed in 1988. The dosages originally pro-

posed have since been modified but the principle that supplementation should be an automatic part of the early-stage emergency response has remained. The importance of vitamin A supplementation has since been strengthened with the publication of a review in 1994 showing that supplementation reduces mortality among under-fives (6 to 59 months) by about 23 per cent in populations with clinical signs of vitamin A deficiency.

During a nutritional emergency, supplementation for children should normally be carried out as soon as possible and prior to a needs assessment. The recommended doses for preventive use are given in **Table 1**. However, if an emergency is occurring in a setting with low baseline child mortality and the diet is adequate, the need for blanket supplementation may be less compelling.

**Table 1: Supplementation to prevent vitamin A deficiency**

Population group	Oral dose	Frequency of dose
Infants 0-6 months	50,000 IU	Once
Infants 6-12 months	100,000 IU	Every 4-6 months
Children > 1 year	200,000 IU	Every 4-6 months <sup>1</sup>
Pregnant and other fertile women	Not more than 10,000 IU	Daily
Breastfeeding women	200,000 IU	Once during the first 8 weeks after delivery <sup>2</sup>

<sup>1</sup> Adequate protection can also be achieved with smaller, more frequent doses, e.g., 10,000 IU weekly or 50,000 IU monthly.

<sup>2</sup> If the mother is not breastfeeding, the supplement should be given within 6 weeks of delivery to prevent any risk of teratogenicity (malformation of the baby) in a subsequent pregnancy.

Source: World Health Organization (2000) *The Management of Nutrition in Major Emergencies*. WHO: Geneva.

### Iron and folate supplementation for pregnant women

Many women entering pregnancy have low iron stores and, as the demand for iron during pregnancy is high, the situation tends to worsen with time. This problem occurs widely both in emergency and non-emergency situations. Iron and folate supplementation remains one of the corner stones of micronutrient deficiency prevention. All women should receive both iron and folate supplementation for at least six months of pregnancy. Where the prevalence of anaemia in pregnant women is 40 per cent or higher this supplementation should continue for three months after birth.

Despite the importance of this intervention adherence to iron and folate supplements is often poor due to lack of appreciation of their benefits and side effects such as nausea (sickness) and constipation. Research has shown beneficial effects of weekly as well as daily supplementation, but daily supplementation remains the intervention recommended by WHO.

### Multiple micronutrient supplementation tablets during pregnancy

Recently, there has been a move towards using a multiple micronutrient tablet as a replacement for iron and folate supplementation programmes. It has been considered that in populations where multiple micronutrient deficiencies may exist, it is more appropriate to provide a supplement containing a wider range of essential micronutrients. Several trials have been carried out on the use of a tablet formulated by UN agencies that uses 15 different micronutrients. Evidence strongly suggests that the use of these tablets is associated with an increase in birth weight in malnourished populations. However, there is currently no consensus on whether this results in a decrease in adverse outcomes or the cost-effectiveness of the intervention.



Table 2: Iron and folate supplementation for pregnant women

Prevalence of anaemia in pregnant women	Daily oral dose		Duration of supplementation
	Iron	Folic acid	
< 40%	60mg	400µg	6 months of pregnancy
≥ 40%	60mg	400µg	6 months of pregnancy, continuing to 3 months post-partum

Source: World Health Organisation, *The Management of Nutrition in Major Emergencies*, WHO, Geneva, (2000).

### Challenge 1: Iron supplementation of children in Zanzibar: 2002-2003

Until recently WHO recommended iron supplementation for all children in populations where the diet supplied inadequate quantities of iron and iron-fortified foods were not available.

However, a study carried out in Zanzibar between 2002 and 2003 found that there may be adverse health consequences if iron supplements were given to children who were not iron deficient and were living in areas where malaria or other infectious disease transmission was high. Following a meeting in 2004, WHO issued the following statement:

*“The findings of the trial in Zanzibar suggest that caution should be exercised in settings where the prevalence of malaria and other infectious diseases is high. Until the WHO recommendations are revised it is advised that iron and folic acid supplementation be targeted to those who are anaemic and at risk of iron deficiency. They should receive concurrent protection from malaria and other infectious diseases through prevention and effective case management... ”*

*These conclusions should not be extrapolated to fortification or food-based approaches for delivering iron, where the patterns of iron absorption and metabolism may be substantially different... ”*

*It is necessary to take the health environment into account when designing iron supplementation programmes as public health measures so that the benefits can be optimized without incurring significant risk.”*

More research is required to fully understand the best ways of safely delivering preventive iron supplementation in areas where malaria and other infectious diseases are prevalent.

**Untargeted blanket supplementation of children with iron supplements should be avoided in areas where malaria is prevalent. In the absence of specific guidance, iron supplements should be assumed to include Micronutrient Powders. The treatment of diagnosed iron deficiency anaemia should continue using the established supplementation regimens along with prevention and control programmes for malaria and helminth infections.**

Source: From ‘Iron supplementation of young children in regions where malaria transmission is intense and infectious disease highly prevalent’, Joint Statement, World Health Organization and the United Nations Children’s Fund, 2006; and

Sazawal, S., et al., ‘Effects of routine prophylactic supplementation with iron and folic acid on admission to hospital and mortality in preschool children in a high malaria transmission setting: community-based, randomised, placebo-controlled trial’, *The Lancet*, 367, 2006.

### Use of supplements to prevent epidemics of other micronutrient diseases

Supplementation can be used in non-routine programmes to prevent epidemics of micronutrient deficiency diseases in high-risk populations. Examples include the use of vitamin C tablets to prevent scurvy in Afghanistan and the use of niacin tablets to prevent pellagra in Angola.

In these cases, where supplements must be delivered to the entire population or high-risk group, programmes cannot use the distribution mechanisms used for routine supplementation. In general, these types of supplement distributions pre-

sent challenging logistic issues which may make them difficult to sustain over a prolonged period. In addition, the acceptability of regular supplement consumption may be called into question by the target population, resulting in poor adherence and programme coverage.

Distribution of micronutrient supplements has proven to be effective, at least in the short term, for preventing epidemics. They are a valuable approach to consider using in situations where a rapid, short term solution is needed to a serious and urgent problem.

**Case example 6: Using vitamin C supplementation to prevent a scurvy epidemic in Afghanistan: 2002**

In March 2002, there were reports of a hemorrhagic fever outbreak in western Afghanistan. It was later confirmed that the hemorrhagic symptoms and increased mortality were actually due to scurvy. A rapid assessment confirmed the cases clinically, estimated a prevalence rate of 6.3 per cent (a severe public health problem), and determined that the attack rates peaked each year in January and February (the end of the winter).

Many Afghans had limited dietary diversity due to isolated locations, lengthy winters, continuing drought, asset depletion and loss of *livelihoods* (means of making a living). After numerous food and fortification options to prevent future outbreaks had been considered, vitamin C tablet supplementation was selected because of the relatively rapid response time compared with other prevention methods. A three-month course of vitamin C tablets was distributed to 827 villages in at-risk areas.

The tablets were acceptable to the population and compliance was good. No cases of scurvy were reported for the winter of 2002-2003. The case example from Afghanistan demonstrates that scurvy can occur in non-refugee or non-displaced populations, that vitamin C supplementation can be an effective prevention strategy and that the humanitarian community should address prevention of scurvy in outbreak-prone areas.

Source: Cheung, E., et al., 'An epidemic of scurvy in Afghanistan: assessment and response', Food and Nutrition Bulletin, 24, 2003.

**Case example 7: Difficulties in using supplement tablets to prevent pellagra in Angola: 1999**

In the late 1990s, during the Angolan civil war, MSF began to diagnose cases of pellagra in Kuito, in central Angola. This marked the beginning of a large and persistent outbreak of pellagra. Analysis of the food aid ration at that time showed that it did not provide enough niacin. As other food commodities such as corn soya blend (CSB) were not yet available a distribution of vitamin B complex tablets to all women aged 15 and over was organized as an emergency response in December 1999. The target group was chosen as they were suffering the highest attack rate, and because of a lack of resources to distribute to the entire population. Thirty tablets, to last one month, were distributed to each woman. A nutritional survey conducted in December 1999 assessed compliance with the prescribed vitamin B complex tablets by counting the number of tablets left in the distribution bag after a set number of days. The survey found low compliance.

It was concluded that a vitamin B tablet distribution campaign did not seem to be the most effective solution to control this pellagra outbreak. Furthermore, targeting women with tablets was an emergency measure, but not a satisfactory option, as all strata of the population were probably deficient in niacin.

At a multi-agency meeting held in January 2000 it was agreed that the general ration should be supplemented with CSB (rather than groundnuts as the latter lacks riboflavin and pyridoxine, both of which are necessary for the conversion of tryptophan into niacin) and that the priority group for receiving the expanded ration should be the displaced.

Source: Baquet, S. and M. van Herp, 'A Pellagra epidemic in Kuito, Angola', Field Exchange, 10, 2000.

**7 Promotion of home gardening and agricultural development**

The distribution of seeds, tools and other agricultural inputs may allow populations to grow vegetables and fruit or livestock for home consumption or for sale. However, access to land may be a major constraint, particularly in refugee camps or in areas which are insecure, e.g., due to land mines. Water availability may also be a limiting factor.

One approach to try to maximize use of available land and water resources involves so called multi-story gardening. This has been piloted in refugee camps in Kenya and more recently in Ethiopia. It involves the use of old food aid sacks which are then filled with earth and used to grow crops. The crops can be watered using household waste water. While this is an in-

novative idea that has great potential to improve diet diversity, evidence is currently lacking about the yield that can be obtained with these gardens and whether it would contribute significantly to household nutrient intake.

**8 Increasing income and improving access to markets**

Increases in income can help to improve the intake of micronutrients through increasing the purchasing power of beneficiaries and therefore their dietary diversity. Vouchers for food or cash may be used to increase purchasing power while micro-credit and enterprise development may promote sustainable development. In all cases adequate market access is essential.

## Challenge 2: Use of multiple micronutrient supplements in emergencies

UNICEF and WHO have recently developed two formulations for a daily multiple micronutrient supplement for pregnant women and children. In 2006, together with WFP, they issued recommendations for their use in emergencies.

These recommendations state that:

*“Pregnant and lactating women should be given this supplement providing one RNI of micronutrients daily, whether they receive fortified rations or not. Iron and folic acid supplements, when already provided, should be continued. When fortified rations are not being given, children aged 6 to 59 months should be given one dose each day of the micronutrient supplement shown in Table 1; when fortified rations are being given, children aged 6 to 59 months should be given two doses each week of the micronutrient supplement... ”*

*Furthermore, vitamin A supplements should continue to be given to young children and mothers post-partum according to existing recommendations. Breastfeeding and appropriate complementary feeding should also continue to be promoted actively... ”*

*Moreover the continued need for supplements and fortified foods should be assessed periodically during and after the emergency. As the crisis wanes, the general distribution of the supplement is likely to be reduced and then increasingly targeted to specific groups.”*

In practice, most programmes trying to deliver these multiple micronutrient supplements have used micronutrient powders as the delivery mechanism. The majority of programmes have targeted children. However, while there is a lot of current research in this area, published evidence and operational experience in emergencies remains limited. There is also a lack of established protocols and experience for implementing the recommendation of a phased reduction in distributions as the emergency improves.

**While there has been an increase in the use of micronutrient powders to deliver supplements in emergency affected populations, experience with this approach remains limited and their use in any given context requires careful planning and monitoring.**

Source: From ‘Preventing and controlling micronutrient deficiencies in populations affected by an emergency. Multiple vitamin and mineral supplements for pregnant and lactating women and for children aged 6 to 59 months’, Joint Statement, World Health Organization, the World Food Programme and the United Nations Children’s Fund, 2006.

However, sometimes the most vulnerable households and individuals may be the ones least likely to benefit from these types of interventions.

### 9 Promotion of recommended infant feeding practices

Promotion of *exclusive breastfeeding* and appropriate *complementary feeding* practices are critical public health interventions that also contribute to maintaining micronutrient status. Exclusive breastfeeding up to six months of age, followed by the introduction of complementary foods with continued breastfeeding for two years or longer are very important for the nutritional status and health of children. Complementary foods for infants should be rich in energy and nutrients, as the growing child requires these for optimal growth and development.

It may be extremely difficult for carers to obtain access to adequate complementary infant foods during emergencies.

### 10 Ensuring adequate health care and a healthy environment

Good health is very important in maintaining good nutrition and micronutrient status. Below are some examples of public health interventions that may contribute to preventing micronutrient deficiencies:

- Vaccination against measles, which is important in the control of xerophthalmia
- Water, sanitation and hygiene promotion to control diarrhoea
- De-worming to control anaemia due to intestinal parasites such as hookworm or schistosomiasis
- Malaria control (e.g., insecticide-treated mosquito nets, vector control, etc.) to combat anaemia
- Health and nutrition promotion activities, e.g., an appropriate sun exposure as protective factor against rickets

## 11 Ensuring access to adequate non-food items

Household economic decisions are critical in determining the diet diversity and micronutrient status of all its members. In situations of scarce resources, food may not be, or may not be perceived to be, the top priority. If households are short of non-food items (e.g., cooking pots, soap or assets such as tools) then they may choose to use their available food stocks or other assets to procure these, rather than to improve the quantity or quality of their diet. This implies that nutritional assessments should take into account the availability of non-food items and consider taking measures to ensure their availability as part of a nutrition strategy. As seen in **Case example 5** (above), the sale of food aid may be a sign of distress and a shortage of non-food items, rather than excess provision of food aid.

### Treatment

*Micronutrient deficiency diseases* require urgent medical treatment. This will usually take the form of oral supplement tablets or capsules. A relatively new approach involves using micronutrient powders that can be added to the normal food to increase micronutrient intake. These have been shown to be effective for the treatment of iron deficiency anaemia.

In some situations the prevalence of a micronutrient deficiency disease may be so high that blanket treatment of a population is justified. However, if this is done the possibility of excessive intake for those who are not suffering from deficiency must be taken into account.

Treatment doses for micronutrient deficiencies are given in many standard medical textbooks and field manuals. There is some variation in the doses recommended by different sources. **Table 3** shows a summary of some recommended treatments for selected micronutrient deficiency diseases.

The importance of appropriate treatment is illustrated in **Case examples 8** and **9**. Recognition and treatment of these diseases has the potential to greatly reduce the burden of morbidity and mortality in a population. However, prevention is, almost always, better than a cure. Appropriate diagnosis and treatment of cases should always be accompanied by the development of a prevention strategy using the different approaches outlined earlier in the module.

Methods to effectively tackle micronutrient malnutrition are necessarily diverse. Significant challenges remain at both the technical and policy levels, and continued efforts are required if we are to reduce and eventually eliminate this serious public health problem during emergencies.

### Case example 8: Reducing infant mortality by treatment of beriberi in Thailand: 1999

During a research study on malaria an extremely high infant mortality was observed in a refugee population on the north-western border of Thailand. Between 1987 and 1990 the infant mortality rate was 16 per cent and about 7 per cent of all infants were dying from this unrecognized micronutrient deficiency disease. After identification of infantile beriberi as the major cause of mortality standardized treatment was introduced. This involved: intra muscular injection of thiamine (50 mg) in infants suffering from the syndrome; supplementation of mothers who showed symptoms with 100 mg thiamine hydrochloride per day during pregnancy and 10 mg per week during lactation until 9 months post-partum; and a supplementary food ration for all pregnant women of 500 g soybeans and 4 eggs per week.

In response to these measures the case fatality rate for infantile beriberi fell from almost 100 per cent to 7 per cent and the overall infant mortality decreased from 183 to 78 deaths per 1000 live births.

Source: Luxemburger, C., et al. (2003) 'Beriberi: the major cause of infant mortality in Karen refugees', *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 97(2).

Case example 9: Treating scurvy in prison populations in East Africa: 2005

While visiting prisoners in East Africa, health delegates of the International Committee of the Red Cross (ICRC) encountered prisoners suffering from a hitherto undiagnosed ‘mysterious’ illness, consisting mainly of swollen and hard legs. Patients had not improved after various treatments given by the local health centre or hospital. The ICRC set out to investigate the nature of this disease in 10 prisons and examined 133 prisoners with the suspected clinical symptoms described as ‘wooden leg’ syndrome. Serum ascorbic acid levels were measured and a food basket analysis done. The diagnosis of scurvy was confirmed. The clinical presentation of scurvy in these East African prisons seems to be somewhat different from the classic descriptions, but is in line with historic records of the disease.

All patients responded to standard treatment with oral ascorbic acid. Treatment was easy and inexpensive, and the response to treatment was quick. They concluded that scurvy remains a problem in prisons in Africa and clinicians working in prisons need to be aware of its presence and its presentations.

Source: Bennett, M. and R. Coninx, ‘The mystery of the wooden leg: vitamin C deficiency in East African prisons’, *Tropical Doctor*, 35(2), 2005.

Table 3: Recommended treatments for some important micronutrient deficiency diseases

Disease	Recommended treatment	References
<b>Anaemia</b>	<i>Remember to also look for and treat non-nutritional causes of anaemia such as sickle cell, hookworm, schistosomiasis and malaria.</i>	
Severe iron deficiency anaemia	Children < 2 years      25mg iron and 100-400µg folic acid per day for 3 months Children 2-12 years      120mg iron and 400µg folic acid per day for 3 months Adolescents and adults      600mg iron and 400µg folic acid per day for 3 months (including pregnant women)	1
Moderate iron deficiency anaemia	See the section on prevention of anaemia	
<b>Xerophthalmia (vitamin A deficiency)</b>	<ul style="list-style-type: none"> <li>- Give 3 doses of oral vitamin A at day 1, day 2 and in week 3. Curative doses of vitamin A 0-6 months                      50,000 IU 6-12 months                      100,000 IU &gt; 1 yr (including adults)      200,000 IU</li> <li>- With the first dose, give topical antibiotic eye ointment (e.g., tetracycline 1% or chloramphenicol 1%) for 10 days.</li> <li>- If the cornea is involved, close the eye and gently cover with an eye pad. Refer the patient to a specialist.</li> <li>- NB: High dose vitamin A supplementation of pregnant women risks teratogenic effects (birth defects) in their unborn children. However, if there are severe signs of active xerophthalmia it becomes essential to weigh this risk against the possible serious consequences of vitamin A deficiency for both mother and foetus. In these circumstances the high dose treatment schedule given above may be followed for pregnant women.</li> </ul>	1, 2
<b>Rickets (vitamin D deficiency)</b>	Oral administration of 5000 IU of vitamin D daily for 4-6 weeks followed by 1000IU daily for 6 months The supplements are usually given in capsules and are commonly derived from fish liver oils.	1

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1 World Health Organization, *Management of Nutrition in Major Emergencies*, WHO, Geneva, 2000.

2 *Oxford Handbook of Tropical Medicine*, 3rd Edition, Oxford University Press, Oxford, 2008

Table 3: Recommended treatments for some important micronutrient deficiency diseases (continued)

Disease	Recommended treatment	References
<b>Beriberi</b>		
Adult	Critically ill adults should be given 50-100mg thiamine very slowly intravenously followed by 3-5mg per day orally for at least 6 weeks.	1
Infantile	In the case of severe heart failure, convulsions or coma, 25-50mg thiamine should be given very slowly intravenously, followed by a daily intramuscular dose of 10mg per day for about 1 week. In less severe cases give 10 mg thiamine per day orally or intramuscularly for 1 week followed by 3-5mg per day orally for at least 6 weeks.	1
Lactating women	Symptomatic women with mild beriberi should receive 10mg thiamine per day orally for 1 week, followed by 3-5mg per day orally for at least 6 weeks to prevent the development of acute beriberi in their infants.	1
<b>Ariboflavinosis</b>	Give 2-5mg of riboflavin orally per day until symptoms resolve.	2
<b>Pellagra</b>	Give a daily dose of 300mg nicotinamide orally for 2-4 weeks. NB: Try to avoid using nicotinic acid as this may cause flushing of the skin, nausea, vomiting, tingling and numbness.	1
<b>Scurvy</b>	Give ascorbic acid divided in 3 oral doses for 2 weeks: infants 50mg/day; children 150mg/day; adults 500mg/day. This is followed by preventive treatment: children and adults: 50-100mg/day. A larger dose of 1 gram per day ascorbic acid for 2-3 weeks is also recommended by WHO but may not be appropriate in children.	1, 2

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1 World Health Organization, *Management of Nutrition in Major Emergencies*, WHO, Geneva, 2000.2 *Oxford Handbook of Tropical Medicine*, 3rd Edition, Oxford University Press, Oxford, 2008